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GEOLOGY AND PALEONTOLOGY.

The Origin of Petroleum and Gas. — The following statements bring before us the principal views as to the origin of petroleum, viz:

1. Petroleum is produced by the primary decomposition of organic matter, and mainly in the rocks that contained the organic matter. Of this view, Hunt is one of the chief advocates.

2. Petroleum results from the distillation of organic hydrocarbons contained in the rocks, and has generally been transferred to strata higher than those in which it was formed. Newberry and Peckham have been quoted at length in support of this general theory. Newberry holds that a slow and constant distillation is in progress at low temperatures. Peckham refers the distillation of the petroleum of the great American fields to the heat connected with the elevation and metamorphism of the Appalachian mountain system.

These views as to the date of the origin of petroleum and gas are seen to cover almost all the possibilities in regard to the subject. Hunt believes petroleum to have been reduced at the time that the rocks that contain it were formed, once for all. Newberry believes it to have been in process of formation, slowly and constantly, since the strata were deposited. Peckham refers it to a definite and distant time in the past, but long subsequent to the formation of the petroliferous strata. He supposes it to have been stored in its subterranean reservoirs from that time to the present.

In these several statements as to origin, two questions are seen to be especially prominent, viz: What particular kinds or classes of rocks are the sources of petroleum? and, What is the value of the chemical processes involved in its production?

In answering the first question, we find the views of Hunt and Newberry distinctly opposed to each other. Hunt counts limestones the principal source of petroleum, and denies that it has been produced by distillation from bituminous shales; while Newberry finds in these shales the main source of both oil and gas, and vigorously opposes the view that limestones are ever an important source of either.[1]

It is not necessary to follow the discussion in relation to these points further. It is enough to say that in the light of present knowledge each statement is sustained as to its particular affirmations and inconclusive as to its general denials. Petroleum is undoubtedly indigenous to and derived from certain limestones, as Hunt has so strongly asserted. On the other hand, Newberry's doctrine that the great supplies of the Pennsylvania field are derived from Devonian shales is becoming more firmly established and widely accepted every year, though it seems likely that he has laid too much stress on bituminous shales. In other words, the theories are not incompatible with each other. Different fields have different sources. We can accept without inconsistency the adventitious origin of the oil in Pennsylvania sandstones, and its indigenous origin in the shales of California or in the limestones of Canada, Kentucky, or Ohio.

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[1] Rept. Geol. Survey Ohio, Vol. I., p. 159.

The double origin of petroleum from both limestones and shales—and it is not necessary to exclude sandstones from the list of possible sources—deserves to be universally accepted. In confirmation of this double origin, it is coming to be recognized that the gas and oil derived from them two sources—limestones and shales—generally differ from each other in noticeable respects. The oil and gas derived from limestones contain larger proportions of sulphur and nitrogen than are found in the oil and gas of the shales. Nitrogen renders the oils unstable, and sulphur compounds impart to them a rank and persistent odor from which they can be freed only with great difficulty. In the case of the oil-bearing shales of California, the petroleum is evidently derived from the animal remains with which the formation was originally filled. In composition this oil agrees with the limestone oils already described. It contains more than four times as much nitrogen as the Mecca oil of northeastern Ohio, and its percentage of sulphur is very high. Peckham says of the Pennsylvania oils:[2]

"The exceedingly unstable character of these petroleums, considered in connection with the amount of nitrogen that they contain and the vast accummulations of animal remains in the strata from which they issue, together with the fact that the fresh oils soon become filled with the larvæ of insects to such an extent that pools of petroleum become pools of maggots, all lend support to the theory that the oils are of animal origin."

He speaks again of this class of petroleums as formed of animal matter that has not been subjected to destructive distillation.[3]

It now appears as if oil and gas derived from animal remains can be distinguished from those of the bituminous shales by the characters above described. Certain it is that the "limestone oils" differ in physical characteristics from the Pennsylvania oils, for example, in a marked degree. They are dark in color; they are heavy oils, their gravity generally ranging from 34° to 36° Beaumé, though sometimes falling to 40° or even 42°; they have a rank odor, arising from the sulphurous compounds which they contain. The oils of Canada, Kentucky, Tennessee, and of the fields in northwestern Ohio all agree in these respects, and the oil and gas of the Utica shale and Hudson River group of the state fall into the same category.

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[2] Op. Cit., p. 69.

[3] Ibid., p. 71.

In the preceding statements the organic matter of the bituminous shales has not been positively referred to a vegetable source. Such a source is highly probable, but it cannot be said to be fully demonstrated until the origin of the so-called *Sporangites* of the shales is finally determined. There are a few geologists who are inclined to refer these forms to hydroid zoophytes (animal) rather than, with Dawson, to marine rhizocarps (vegetable). Whatever their origin, they give rise to petroleum and oil of a definite character, which is in marked contrast to that of the limestone oils.

Which of these theories as to the mode and time of origin of petroleum has the most to commend it?

In conclusion, a few of the previously stated propositions in regard to the origin of petroleum that seem best supported will be concisely summarized:

1. Petroleum is derived from organic matter.
2. It is much more largely derived from vegetable than from animal substances.
3. Petroleum of the Pennsylvania type is derived from the organic matter of bituminous shales, and is of vegetable origin.
4. Petroleum of the Canada and Lima type is derived from limestones, and is of animal origin.
5. Petroleum has been produced at normal rock temperatures (in Ohio fields), and is not a product of destructive distillation of bituminous shales.
6. The stock of petroleum in the rocks is already practically complete.—*Edward Orton in Ann. Report U. S. Geol. Survey, 1886–'87. (Published 1890).*

Production of Salt in the United States.—In 1887 the production of salt in the United States was 7,831,962 barrels of 280 pounds each. Of this, the value was estimated at $4,093,846. Michigan produced 3,944,309 barrels; New York, 2,353,560 barrels; Ohio and West Virginia, about 600,000; Kentucky, Tennessee, and Virginia, about 200,000; or about 7,000,000 barrels in all produced from the evaporation of brines. In addition, Louisiana produced 225,000 barrels from the quarries of rock salt at New Iberia; Utah, 325,000 barrels, mostly from the waters of Salt Lake, but a small portion from the quarries of rock salt in Jaub and Sevier counties. California produced in former years over 200,000 barrels, chiefly from the evaporation of sea-water in San Francisco Bay, but in 1887 the production was only 28,000 barrels, in consequence of a combination of the operators to reduce the output and enhance the price.

In Kansas a discovery of rock salt has recently been made, which promises to be an important addition to the resources of the State. The salt beds lie near the base of the Trias, and occupy a large area in the southern portion of the State, extending into Texas. In seven localities cited by Mr. Robert Hay, in the biennial report of the Kansas State Board of Agriculture, the rock salt lies at depths varying from 450 to 925 feet, and the thickness is from 75 to 250 feet. The production in 1888 was about 2,000 barrels.

In New York the production of salt is about equally divided between the reservation at and about Syracuse and the Warsaw district in Western New York, the latter having increased with great rapidity. The salt from the Onondaga Reservation is obtained from the evaporation of the brine of about 40 wells; these wells have an average depth of 330 feet, and the strength of the brine is about 70 per cent. of the salometer.

In the Warsaw district there are about 50 wells in operation, from 800 to 2,500 feet in depth. According to the report of Dr. F. E. Englehart the entire production in 1887 was 6,072,000 bushels.

The well at Piffard, belonging to the New York Salt Company, is producing rock salt, and is the pioneer enterprise of this kind in the State. The first bed of salt was reached at a depth of 938 feet. This bed is two feet in thickness, and is separated from the second bed, 12 feet in thickness, by 4 feet of shale. The third salt bed was 6 feet thick and 28 feet below the second; and the fourth bed, 9 feet below the third, was 58 feet in thickness.—*J. S. Newberry, in Transactions of the N. Y. Academy of Sciences, Nov., 1889.*

Geological News.—General.—O. Feistmantel, in his account of the geology of South Africa, parallels the Karroo formation with the Gondwana of Hindustan. The upper beds of this formation he considers equivalent to the Mesozoic coal-measures of Eastern Australia, the middle Karroo to the Hawksbury beds, and the lower Karroo to the upper coal-beds and upper marine beds, which last are probably representative of the Permian and Carboniferous of general geology, so that the upper and middle Karroo may represent respectively the Lias and the Trias. The cape formation is paralleled with the Vindhya of Hindustan, which probably represents the lower Carboniferous and Devonian. The South African primary includes metamorphic and archaic.

The Imperial Geological Survey of Japan has publised a reconnaissance map, scale 1–400,000; sectional maps, scale 1–200,000; and agronomic maps of twice the latter scale. The reconnaissance sheets comprise North Japan between 138° E. and 38° N., and N. Japan from 38° to 40° N., while the sectional maps include the provinces of Shikoaka, Fuji, Kofu, Veda, Nagano, Izu, Yokohama, Tokio, Mayebashi, Nikko, Kakusa, Chiba and Mito. T. Harada, writing of the geotectonic "membering" of Japan, states that the outer oceanic curve of the islands, though poor in volcanoes, is rich in seismic activity, while the inner side is rich in recent eruptive masses, active volcanoes and thermal springs. The Japanese Sea is a great "Kesselbruch" (chaldron-fissure), and the archipelago is its eastern border.

Palæozoic—The *Geological Magazine* for March, April, and May of this year contains notes on the palæontology of Western Australia. A. H. Foord describes the gastropods, brachiopods, etc., including the new species of Spirifera, while G. J. Hinde gives the corals and polyzoa, with a new genus of the former.

In a recent number of the *Quar. Jour. Geol. Soc.* T. Rupert Jones describes many new species of palæozoic Ostracoda from North America, Wales, and Ireland.

G. J. Hinde describes (*Quar. Jour. Geol. Soc.*, Feb. 1, 1890) a new genus of siliceous sponges from the lower calcareous grit of Yorkshire, and names it Rhaxella. Small globules of silica take the place of elongated spicules in this sponge.

Mesozoic.—In the Wealden near Hastings Mr. R. Lydekker identifies five distinct species of Iguanodon, viz: *I. bernissartensis* Dollo, *I. mantelli*, *I. dawsoni* Lyd., *I. fittoni* Lyd., and *I. hollingtoniensis* Lyd. He also maintains the existence in the English Wealden of two species of Megalosaurus, one of which is *M. dunkeri*, while the other is yet undescribed.

Comoliosaurus (*Pliosaurus*) *portlandicus* has been proved to range upwards to the middle Purbeck.

G. Cotteau has commenced the study of the cretaceous echini of Mexico on six species collected by S. R. Castillo, the director of the mines. Three of these forms, *Pseudocidaris saussurei* Loriol, *Holectypus castilloi* Cotteau, and *Heteraster mexicanus*, are peculiar to Mexico, but the three others have previously been found outside of that country. *Diplopodia malbosi* is common enough in France in the aptian, as is also *Salenia prestnesis* Desor. *Laniera lumen*, from the higher cretaceous beds, is sufficiently common in Cuba.

According to M. A. de Grossenore, the callovian beds east and west of the primitive mass of La Vendee have some fossils, unlike those of the Paris basin, but like those of the callovian of the Alps and Carpathians. *Terebratula antiplecta* occurs here, and is also found in the Tyrol and in Galicia. There also occur Terebratulæ of the groups *nucleata* and *bivallata*, and *Rhynchonella acutiloba*. The callovian of Cape Mondago (Portugal) is analogous.

Tertiary.—The discovery of a new mandible of Dryopithecus has recently led M. A. Gaudry to compare it with the lower jaw of man and of the existing apes, with the result that it proves to be inferior in type, not only to the former, but to most of the latter. The lengthened jaw and the contracted space left for the tongue are the two points chiefly dwelt upon. In these respects the gorilla is below the orang, which again is inferior to the chimpanzee. M. A. Milne-Edwards stated that the Dryopithecus was nearer to the gorilla than to any other existing ape, and that the prognathism of the jaw was so excessive that one might suppose the animal to have been quadrupedal.

A giant example of a fossil tortoise, with a carapace five feet and a half in length and rather more than three feet nine inches wide, has been discovered by M. Deperet in the red clays of the upper Miocene of Mont Leberon. Portions of this species had been previously found by M. A. Gaudry, but the present specimen was in astonishingly complete preservation, the body standing nearly in a natural position in the side of a ravine. The carapace was somewhat crushed with the superincumbent weight. This tortoise is larger than any other known living or fossil form except *T. atlas* of the Himalayas. It is, however, so very near in all important characters to *Testudo perpiniana*, which occurs in the environs of Paris, and has been found with a length of four feet, that it may probably be best regarded as a variety of that species. Though *T. perpiniana* is of Pliocene age, and the new fossil was found in the uppermost beds of the Miocene, the resemblance is great.

In a recent issue of the *Quarterly Journal* of the Geological Society of London, Mr. R. Lydekker treats of the presence of the Striped Hyæna in the Pliocene beds of the Val d'Arno, describing the remains in answer to the assertion that they belonged to *H. crocuta.* It is curious that these two species do not now exist in the same localities, though in ancient times they seem to have done so; also that they have to a considerable extent interchanged their localities.

Recent.—Capt. A. W. Stiffe recently read a paper before the Geological Society of London concerning the glaciation of the Sind and Jhelam valleys in the Himalayan mountains of Kashmir. He stated his belief in the gigantic character of the ancient glaciation and gave a general description of the features of the Sind valley and of the existing glaciers near Sonawarg. At this point there are snow fields at a lower level than the foot of the glacier, which is rather unusual. Very perfect typical older terminal moraines exist at Sonawarg, some of them four miles below the present termination of the glaciers, and at an elevation of 10,000 feet. These once blocked up the Sind River, and the sections cut by the rivers through these moraines are remarkable. The glaciated appearance of the gorge below Sonawarg is very striking, and the entire Sind valley presents a continual succession of moraines. The hillsides of the valley exhibit a comparatively rounded outline to a height of 2000 feet or more, while above this they are rugged.

The existing lakes of the Kashmir district were referred by the writer to glacial action—they were the remains of a former much more extensive alluvial lake which had been largely silted up; he then treated of the supposed glacial deposits of the Jhelam valley, and stated that the whole valley from Baramilla to Mozufferabad contained extensive glacial or moraine deposits. In conclusion attention was drawn to the great deposits of travelled granite blocks at Rampoor, blocks which from their size, and from their difference from the neighboring rocks, must certainly have been carried thither by the action of glaciers.